UNIVERSITAT POLITÈCNICA DE CATALUNYA
BARCELONATECH
Escola d'Enginyeria de Barcelona Est

TREBALL FI DE GRAU

Grau en Enginyeria de la Energia

ELECTRIFICATION PROJECT IN A BOX FACTORY

Volume I

Memory

Autor: Nil Domenech Ruiz
Director: Rodolfo Oseira Goas

Convocatòria: Juny 2017

Resum

Aquest treball tracta del disseny de la electrificació de baixa tensió d'una fàbrica de caixes de cartró. El treball s'inicia amb la llista de tots els consums previstos a la fàbrica. A partir d'aquí es contempla la connexió com a únic usuari d'un transformador propi que alimenta tot el consum, no sent aquest transformador objecte del projecte.

En aquest projecte es dimensionen les línies de alimentació de les càrregues a partir dels subquadres, les línies que alimenten aquests subquadres, els subquadres i el quadre general de distribució.

A la memòria s'indiquen les càrregues a alimentar, les especificacions legals que ha de seguir cadascuna de les parts del projecte i inclou un resum de totes les proteccions de la instal·lació, un resum de les línies i un resum de cada embarrat, incloent-t'hi les intensitats de curtcircuit.

Als càlculs es detalla el procediment per dimensionar les línies i es mostren tots els resultats.

A la part del plànols s'inclou, en primer lloc, els plànols físics, que son el de situació, emplaçament i el plànol de planta, amb la distribució dels subquadres, el recorregut de les línies que els alimenten, les lluminàries i els consums principals. A continuació es presenten tots els esquemes unifilars de tots els quadres, que inclouen tota la informació de les línies calculades.

Finalment s'inclou un pressupost que està dividit en instal·lació de conductors i instal·lació de subquadres.

Resumen

Este trabajo trata del diseño de la electrificación de baja tensión de una fábrica de cajas de cartón. El trabajo se inicia con la lista de todos los consumos previstos para la fábrica. A partir de aquí se contempla la conexión como único usuario de un transformador que alimenta todo el consumo, sin ser dicho transformador objeto del proyecto.

En este proyecto se dimensionan las líneas de alimentación de las cargas a partir de los subcuadros, las líneas que alimentan estos subcuadros, los subcuadros i el cuadro general de distribución.

En la memoria se indican las cargas a alimentar, las especificaciones legales que debe seguir cada parte del proyecto e incluye un resumen de todas las protecciones de la instalación, un resumen de las lineas y un resumen de cada cuadro incluyendo las intensidades de cortocircuito.

Los cálculos detallan el procedimiento seguido para dimensionar las líneas y se muestras todos los resultados.

En la parte de planos se incluyen, en primer lugar, los planos físicos, que son el de situación, emplazamiento y el plano de planta con la distribución de los subcuadros, el recorrido de las líneas que los alimentan, la distribución de luminarias y los consumos principales. A continuación se muestran todos los esquemas unifilares de cada cuadro, que incluyen información de las líneas calculadas.

Finalmente se incluye un presupuesto que está dividido en instalación de conductores e instalación de cuadros.

Abstract

This project deals about the design of the low voltage electrification of a box factory. The project starts with the list of all the charges of the factory installation. Since here, we starts a connection as only user of a transformer that power all our consume. The transformer doesn't is included in this project.

We design the power lines of the charges since the sub-panels, the lines that power this sub-panels, the sub-panels and the general distribution panel.

In the memory are indicated the loads to power, the legal specifications to be followed by each part of the project and includes a summary of all the installation protections, a summary of the lines and a summary of each panel including the short-circuit currents.

In the calculations volume, are detailed the procedure followed to dimension the lines and are shown all the results.

In the part of planes is included, first the physic planes, that are site, situation and floor planes. Then the volume III have the line diagrams, including information of the lines and the protections.

At the end is included a budget that is divided in conductor installation and panel installation.

General index

Memory index

Memory table index

1. Memory

1.1. Objective of the project

The company “Cantrons del Vallès” wants to open a new box factory, and the objective of this project is to legalize the low voltage electrical installation for this factory in Catalonia, Spain. The company has performed a light study and has provided us with all loads. This project consists in distributing these powers in lines and subpanels, making the calculation of sections, protections against indirect contacts and overcurrent and calculating the bus bars of the general panel and all the subpanels. Always in accordance with the regulations and seeking an adequate selectivity of the protections.

1.2. Company and location

The company is Cartrons del Vallès, S.A. The headquarters of the company is in Sabadell, and they want to open a new factory in Vilanova del Vallès where the paper pulp arrives in reels and there they are in charge of processing it to converse it in cardboard, and then they print it.

They want to open the new factory in Vilanova del Vallès, Pol. Ind. Cal Pinxo C/ Ajuntament de Vilanova del Vallès, 12.

1.3. Location classification

According to the current low voltage regulation (REBT) and the complementary technical instructions (ITC-BT) these local is unrated (Real Decreto 842/2002 of the 2 August of 2002).

The installation of washbasins and collective locker rooms, according to ITC-BT 27, is rated as a local containing a bath or shower.

According to the REBT and the ITC-BT 009, the outdoor lighting is listed as “outdoor lighting”.

1.4. Electricity Supply Company

The supplying company will be Endesa Distribución through the corresponding general connection.

1.5. Supply voltage

The voltage will be in alternating current (AC) with frequency 50 Hz, triphasic (3x400/230 V).

1.6. Necessary power

In this section we will see the power calculated by electrical panels, required for the normal use of the factory.

The total power of the installation will be 1.128,088 kW, but we have decided that the contract power will be 530 kW. The maximum permissible power of the installation, according to the calculations, will be 630 kW. In summary:

- Installed power: 1.128,088 kW
- Maximum permissible power: 630,00 kW
- Contract power: 554,00 kW

We will see what elements are in the panels, and what lines feed this elements.

1.6.1. Electric panel low voltage (EPBT)

Description	Power (W)	Panel Line
Switchboard	50	SWITCHBOARD
Light TS	64	LIGHT TS
Meter plug	500	METER PLUG
Fire pressure pump	176.000	PUMP01
Water purification	11.185	PURIFICATION
Elevator workshop	25.000	WS-ELE
Bullet press	18.000	PRESS

Table 1.6.1.1. EPBT power distribution (Source: Martí Domenech)

Total Driving Power (W)	**213.735**

Total Lighting Power (W)	**64**
Total Power (W)	**213.799**

Table 1.6.1.2. EPBT abstract of power distribution (Source: Nil Domenech)

1.6.2. Sub-panel Weather (SP-WEATHER)

Description	Power (W)	Panel Line
Gas boiler	940	GAS BOILER
Pump production zone	1.810	FACTORY PUMP
Pump warehouse zone	1.810	WAREHOUSE PUMP
Pump offices	80	OFFICES PUMP
Pump dressing room	110	DRESSING ROOM PUMP
Pump ACS	110	ACS PUMP
Geothermal	50.000	CP-GEOTHERMAL
Boiler room Lighting	320	LT-01
Emergency lighting	50	EMERGENCY
Air conditioners	10.000	AIRCOND
Control system pumps and hot production	2.000	CONTROLPUMPS

Table 1.6.2.1. Weather sub-panel power distribution (Source: Martí Domenech)

Total Driving Power (W)	**66.860**
Total Lighting Power (W)	**370**
Total Power (W)	**67.230**

Table 1.6.2.2. Weather sub-panel abstract of power distribution (Source: Nil Domenech)

1.6.3. Sub-panel Warehouse (SP-WAREHOUSE)

Description	Power (W)	Panel Line
Battery charger	1.000	CBA01
Battery charger	1.000	CBA02
Battery charger	7.000	CBA03
Battery charger	20.000	CBA04
Engine lower dock door	368	DOOR01
Engine lower dock door	368	DOOR01
Engine lower dock door	368	DOOR01
Engine outer dock door	368	DOOR02
Engine outer dock door	368	DOOR02
Engine outer dock door	368	DOOR02
Engine outer dock door	368	DOOR02
Engine interior dock door	368	DOOR03
Engine interior dock door	368	DOOR03
Engine access warehouse door	500	DOOR03
Engine outer vehicles door	1.500	DOOR04
Lifting platform	1.472	LP01
Lifting platform	1.472	LP01
Lifting platform	1.472	LP02
Lifting platform	1.472	LP02
Unitherm Roca UL-210 (17 ut.)	1.360	AER01

Unitherm Roca UL-214 (17 ut.)	700	AER02
Unitherm Roca UL-214 (7 ut.)	700	AER03
Services box warehouse zone (11ut.)	4.500	SB
Sub-panel logistic offices	9.660	SP-LOGOFI
Bridge crane	5.875	BRIDGE
Backup		BACKUP

Table 1.6.3.1. Warehouse sub-panel power distribution (Source: Martí Domenech)

Total Driving Power (W)	**62.335**
Total Lighting Power (W)	**660**
Total Power (W)	**62.995**

Table 1.6.3.2. Warehouse sub-panel abstract of power distribution (Source: Nil Domenech)

1.6.4. Sub-panel Compressors (SP-COMP)

Description	Power (W)	Panel Line
Refrigerator dryer	300	DRY01
Compressor Atlas Copco GA30C	30.000	COM01
Compressor Gras-air	15.000	COM02
Compressor Atlas Copco GA30VSD	30.000	COM03
Swichboard vacuum pumps	5.500	SW V P
Cover 1 suction pump	7.750	SUCTION
Cover 2 suction pump	7.750	SUCTION
Plugs	2.500	PLUG01

Service boxes compressors room	3.000	SERVICE BOXES
Lighting rooms	250	LT01
Emergency lighting	50	EMERGENCY

Table 1.6.4.1. Compressor sub-panel power distribution (Source: Martí Domenech)

Total Driving Power (W)	**101.800**
Total Lighting Power (W)	**300**
Total Power (W)	**102.100**

Table 1.6.4.2. Compressor sub-panel abstract of power distribution (Source: Nil Domenech)

1.6.5. Sub-panel logistics offices (SP-OFILOG)

Description	Power (W)	Panel Line
Downlight Led warehouse offices (22 ut)	440	LT01
Led screen warehouse offices (5 ut)	155	LT01
Emergency lighting	65	EMERGENCY
Plugs working zone	1.500	PLUGS 1
Plugs working zone	1.500	PLUGS 2
Plugs working zone	1.500	PLUGS 3
Plugs working zone	1.500	PLUGS 4
Air conditioning/extraction equipment offices	1.500	CLI01
Air conditioning/extraction equipment locker room	1.500	CLI02

Table 1.6.5.1. Logistics offices sub-panel power distribution (Source: Martí Domenech)

Total Driving Power (W)	**9.000**

Total Lighting Power (W)	**660**
Total Power (W)	**9.660**

Table 1.6.5.2. Logistics offices sub-panel abstract of power distribution (Source: Nil Domenech)

1.6.6. Sub-panel EMBA 244 (SP-EMBA244)

Description	Power (W)	Panel Line
Box creator EMBA 244	95.000	BCR01
Tier Signode	4.000	TIER01
Clixes cleaner machine	5.500	CCM01
Hydraulic group	736	GH01
Chains	552	CHAIN01
Chains	552	CHAIN02
Displacement	736	DIS01
Rollers 1	552	ROLL01
Rollers	552	ROLL02
Rollers enter Pallmac	750	PALLMAC
Palletizer Pallmac	4.416	PALLMAC
Roller 1 exit Pallmac	368	PALLMAC
Roller 2 exit Pallmac	368	PALLMAC
Tape exit 1 Pallmac	368	PALLMAC
Tape exit 2 Pallmac	368	PALLMAC
Hydraulic feed Pallmac	368	PALLMAC

Feeder	18.000	FEEDER

Table 1.6.6.1. EMBA244 sub-panel power distribution (Source: Martí Domenech)

Total Driving Power (W)	**133.554**
Total Lighting Power (W)	
Total Power (W)	**133.554**

Table 1.6.6.2. EMBA244 sub-panel abstract of power distribution (Source: Nil Domenech)

1.6.7. Sub-panel EMBA 170 (SP-EMBA170)

Description	Power (W)	Panel Line
Box creator EMBA 170	105.000	BCR01
Elevator EMBA170	1.500	ELEVATOR
Tier Signode	4.000	TIER01
Rollers 1	2.250	ROLL01
Rollers 2	2.250	ROLL02
Rollers 3	2.250	ROLL03
Rollers 4	2.250	ROLL04
Hydraulic elevator	750	HYDELEVATOR01
Hydraulic elevator	1.500	HYDELEVATOR02
Palet Robot EMBA170	25.000	ROBOT
Feeder EMBA170	18.000	FEEDER

Table 1.6.7.1. EMBA170 sub-panel power distribution (Source: Martí Domenech)

Total Driving Power (W)	**164.750**

Total Lighting Power (W)	
Total Power (W)	**164.750**

Table 1.6.7.2. EMBA170 sub-panel abstract of power distribution (Source: Nil Domenech)

1.6.8. Sub-panel Production 1 (SP-PROD1)

Description	Power (W)	Panel Line
Strapping 01	9.400	STR01
Strapping 02	9.400	STR02
Baler 01	5.250	BALER01
Baler 02	5.250	BALER02
Production Semaphore	500	SEM01
Bipal Machine	5.250	BIMA01
Pallets manipulator	2.944	PAMA01
Engine brake rollers 17	600	EBR01
Engine brake rollers 18	600	EBR01
Rollers 01	750	ROLL01
Rollers 02	1.100	ROLL01
Rollers 03	1.100	ROLL01
Rollers 04	1.100	ROLL01
Rollers 05	1.100	ROLL01
Rollers 06	750	ROLL02

Rollers 07	1.100	ROLL02
Rollers 08	1.100	ROLL02
Rollers 09	1.100	ROLL02
Rollers 10	1.100	ROLL02
Rollers 11	750	ROLL03
Rollers 12	1.100	ROLL03
Rollers 13	1.100	ROLL03
Rollers 14	1.100	ROLL03
Rollers 15	1.100	ROLL03
Services Box Production 01	300	TRIFASIC PLUGS
Services Box Production 02	200	TRIFASIC PLUGS
Services Box Production 03	200	TRIFASIC PLUGS
Services Box Production 04	200	TRIFASIC PLUGS
Services Box Production 05	200	TRIFASIC PLUGS
Services Box Production 06	200	TRIFASIC PLUGS
Services Box Production 07	200	TRIFASIC PLUGS
Services Box Production 08	200	TRIFASIC PLUGS
Services Box Production 09	200	TRIFASIC PLUGS
Services Box Production 10	200	TRIFASIC PLUGS
Services Box Production 11	200	TRIFASIC PLUGS
Services Box Production 12	200	TRIFASIC PLUGS

Table 1.6.8.1. PROD1 sub-panel power distribution (Source: Martí Domenech)

Total Driving Power (W)	**57.144**
Total Lighting Power (W)	
Total Power (W)	**57.144**

Table 1.6.8.2. PROD1 sub-panel abstract of power distribution (Source: Nil Domenech)

1.6.9. Sub-panel WORKSHOP (SP-WORKSHOP)

Description	Power (W)	Panel Line
Aerotherm UL210 workshop	80	AER01
Aerotherm UL210 workshop	80	AER01
Watertight screen low level workshop (10 ut)	720	LT01
Watertight screen loft workshop (6 ut)	384	LT01
Plugs computer socket	650	PLUGS
Emergency lighting workshop	50	EMERGENCY
Services box workshop 01	1.500	SERVICEBOX01
Services box workshop 02	1.500	SERVICEBOX02
Services box workshop 03	3.000	SERVICEBOX03
Services box workshop 04	3.000	SERVICEBOX04

Table 1.6.9.1. Workshop sub-panel power distribution (Source: Martí Domenech)

Total Driving Power (W)	**9.810**
Total Lighting Power (W)	**1.154**
Total Power (W)	**10.964**

Table 1.6.9.2. Workshop sub-panel abstract of power distribution (Source: Nil Domenech)

1.6.10. Sub-panel Production 2 (SP-PROD2)

Description	Power (W)	Panel Line
Die cutter ONYX	2.944	DC01
Die cutter TMZ	22.080	DC02
Saw tape	1.472	ST01
Shears	2.208	SHEAR01
Sewing machine (3 ut)	2.208	SM01
Creator 1	10.000	CR01
Creator 2	10.000	CR02
Plugs	2.500	PLUGS
Lower door	1.500	DOOR01
Upper door	1.880	DOOR02
Automatic door	600	DOOR03

Table 1.6.10.1. PROD2 sub-panel power distribution (Source: Martí Domenech)

Total Driving Power (W)	**57.392**
Total Lighting Power (W)	
Total Power (W)	**57.392**

Table 1.6.10.2. PROD2 sub-panel abstract of power distribution (Source: Nil Domenech)

1.6.11. Sub-panel Production 2 (SP-BOBST)

Description	Power (W)	Panel Line
Die cutter BOBST	33.500	DC01

Pallets elevator	736	PE01
Rollers BOBST	5.500	ROLLER
Plugs BOBST	450	PLUGS
Lighting machine BOOBST	750	LT01

Table 1.6.11.1 BOBST sub-panel power distribution (Source: Martí Domenech)

Total Driving Power (W)	**40.186**
Total Lighting Power (W)	**750**
Total Power (W)	**40.936**

Table 1.6.11.2. BOBST sub-panel abstract of power distribution (Source: Nil Domenech)

1.6.12. Sub-panel Transfer (SP-TRANSFER)

Description	Power (W)	Panel Line
Transfer (main engine)	4.000	TRA01
Transfer (Rolling wheels 1)	750	TRA02
Transfer (Rolling wheels 2)	750	TRA03
Transfer (brake)	750	TRA04
Transfer cart	5.500	CAR01
Belt shifter	550	CAR02
Gripper	750	CAR02
Roller transfer (4 ut)	2.250	ROLLER01
Roller transfer (4 ut)	2.250	ROLLER02
Roller transfer (4 ut)	3.000	ROLLER03

Roller transfer (4 ut)	2.250	ROLLER04
Roller transfer (4 ut)	2.250	ROLLER05

Table 1.6.12.1. Transfer sub-panel power distribution (Source: Martí Domenech)

Total Driving Power (W)	**25.050**
Total Lighting Power (W)	
Total Power (W)	**25.050**

Table 1.6.12.2. Transfer sub-panel abstract of power distribution (Source: Nil Domenech)

1.6.13. Sub-panel Exit (SP-EXT)

Description	Power (W)	Panel Line
Vehicle access door	1.840	DOOR01
Pedestrian access door	1.060	DOOR01
Backup		BACKUP

Table 1.6.13.1. Exit sub-panel power distribution (Source: Martí Domenech)

Total Driving Power (W)	**2.900**
Total Lighting Power (W)	
Total Power (W)	**2.900**

Table 1.6.13.2. Ext sub-panel abstract of power distribution (Source: Nil Domenech)

1.6.14. Sub-panel Suction (SP-SUCTION)

Description	Power (W)	Panel Line
Sub-panel ventilator system suction		SP-SUC-VENT
Fulltritur FTM15010 Production	15.000	FTM1500

Val-Veolar 1500	200	VAL-VEOLAR1500
Switchboard	20	SWITCHBOARD
PLC management	200	PLC
Suction valves signal	50	SIGNAL 24V
Backup		BACKUP
Backup		BACKUP

Table 1.6.14.1. Suction sub-panel power distribution (Source: Martí Domenech)

Total Driving Power (W)	**15.470**
Total Lighting Power (W)	
Total Power (W)	**15.470**

Table 1.6.14.2. Suction sub-panel abstract of power distribution (Source: Nil Domenech)

1.6.15. Sub-panel Suction and ventilation (SP-SUC-VENT)

Description	Power (W)	Panel Line
Cut shredder	37.000	CUT
Switchboard	20	SWITCHBOARD
Backup		BACKUP
Backup		BACKUP

Table 1.6.15.1. Suction and ventilation sub-panel power distribution (Source: Martí Domenech)

Total Driving Power (W)	**37.200**
Total Lighting Power (W)	
Total Power (W)	**37.200**

Table 1.6.15.2. Suction and ventilation sub-panel abstract of power distribution (Source: Nil Domenech)

1.6.16. Sub-panel Toilets (SP-TOILETS)

Description	Power (W)	Panel Line
Downlights led men's toilets	300	LT01
Downlights led women's toilets	340	LT02
Emergency lighting	50	EMERGENCY
Hand dryer men's toilets	2.100	HDRY01
Hand dryer women's toilets	2.100	HDRY02
Hand dryer men's changing room	2.100	HDRY03
Hand dryer women's toilets changing room	2.100	HDRY04
Air conditioning/extraction	692	AIR01
Backup		BACKUP
Backup		BACKUP
Automatic door	1.000	AUTDOOR

Table 1.6.16.1. Toilets sub-panel power distribution (Source: Martí Domenech)

Total Driving Power (W)	**10.092**
Total Lighting Power (W)	**690**
Total Power (W)	**10.782**

Table 1.6.16.2. Toilets sub-panel abstract of power distribution (Source: Nil Domenech)

1.6.17. Sub-panel Offices (SP-OFFICES)

Description	Power (W)	Panel Line

Wall sconce low level (3ut)	51	LT01
Waterlight screens low level (4 ut)	288	LT01
Led panel low level (14 ut)	434	LT01
Waterlight screens loft (6 ut)	432	LT01
Wall sconce loft (1ut)	17	LT02
Led panel loft (30 ut)	930	LT02
Downlight led loft (12 ut)	240	LT02
Emergency lighting	50	EMERGENCY
Wall sconce loft (1ut)	17	LT03
Led panel loft (48 ut)	1.488	LT03
Led panel loft (32 ut)	992	LT04
Downlight led loft (19 ut)	380	LT05
Waterlight screens CPD (6 ut)	144	LT05
Emergency lighting	50	EMERGENCY
Plugs 1	1.500	PLUG01
Plugs 2	1.500	PLUG02
Plugs 3	1.500	PLUG03
Plugs 4	1.500	PLUG04
Plugs 5	1.500	PLUG05
Plugs 6	1.500	PLUG06
Air conditioning/extraction 1	2.497	CLI01

Air conditioning/extraction 2	1.705	CLI02
Air conditioning/extraction 3	2.205	CLI03
Recuperator loft	2.500	CLI04
Recuperator low lever	2.500	CLI05
Main access door	1.000	DOOR

Table 1.6.17.1. Offices sub-panel power distribution (Source: Martí Domenech)

Total Driving Power (W)	**21.407**
Total Lighting Power (W)	**5.513**
Total Power (W)	**26.920**

Table 1.6.17.2. Offices sub-panel abstract of power distribution (Source: Nil Domenech)

1.6.18. Sub-panel Informatics (SP-INFORMATICS)

Description	Power (W)	Panel Line
Plugs SAI	1.000	PSAI01
Plugs SAI	1.000	PSAI02
Plugs SAI	1.000	PSAI03
Plugs SAI	1.000	PSAI04
Plugs SAI	1.000	PSAI05
Plugs SAI	1.000	PSAI06
Plugs SAI	1.000	PSAI07
Plugs SAI	1.000	PSAI08
Plugs SAI	1.000	PSAI09

Plugs SAI	1.000	PSAI10
Plugs SAI	1.000	PSAI11
Plugs SAI	1.000	PSAI12
Air conditioning CPD	690	AIRCON01
Rack communications 1	500	RACK COM1
Rack servers 1	500	RACK SER1
Rack communications 2	500	RACK COM2
Rack servers 2	500	RACK SER2
CCTV, interphone	1.500	CCTV
Sub-panel SAI logistics		SP-SAILOG
Sub-panel SAI Rack B		SP-RACK B

Table 1.6.18.1. Informatics sub-panel power distribution (Source: Martí Domenech)

Total Driving Power (W)	**16.190**
Total Lighting Power (W)	
Total Power (W)	**16.190**

Table 1.6.18.2. Informatics sub-panel abstract of power distribution (Source: Nil Domenech)

1.6.19. Sub-panel SAI logistics (SP-SAILOG)

Description	Power (W)	Panel Line
Plugs logistic offices	1.000	PSAI01
Plugs logistic offices	1.000	PSAI02
Plugs logistic offices	1.000	PSAI03

Table 1.6.19.1. SAI logistics sub-panel power distribution (Source: Martí Domenech)

Total Driving Power (W)	**3.000**
Total Lighting Power (W)	
Total Power (W)	**3.000**

Table 1.6.19.2. SAI logistics sub-panel abstract of power distribution (Source: Nil Domenech)

1.6.20. Sub-panel RACK B (SP-RACKB)

Description	Power (W)	Panel Line
Plugs working machines	600	PRACKB01
Plugs working machines	600	PRACKB02
Plugs working machines	600	PRACKB03
Plugs working machines	600	PRACKB04

Table 1.6.20.1. RACK B sub-panel power distribution (Source: Martí Domenech)

Total Driving Power (W)	**2.400**
Total Lighting Power (W)	
Total Power (W)	**2.400**

Table 1.6.20.2. RACK B sub-panel abstract of power distribution (Source: Nil Domenech)

1.6.21. Sub-panel Fire protection (SP-FIREPROT)

Description	Power (W)	Panel Line
Fluorescent tube display (4 ut)	288	LT01
Emergency lighting 1	50	EMERGENCY

Plugs	2.000	PLUG
Wall power grill	1.250	POWER GRILL
Chlorination equipment	250	CHLORINATION
Aerotherm	5.000	AEROTHERM
Thermal resistance tank	3.000	RESISTANCE TANK

Table 1.6.21.1. Fire protection sub-panel power distribution (Source: Martí Domenech)

Total Driving Power (W)	**11.500**
Total Lighting Power (W)	**388**
Total Power (W)	**11.838**

Table 1.6.21.2. Fire protection sub-panel abstract of power distribution (Source: Nil Domenech)

1.6.22. Sub-panel Ventilation (SP-VENTILATION)

Description	Power (W)	Panel Line
Warehouse extractors (3 ut)	2.400	EXTRACT01
Warehouse extractors (3 ut)	2.400	EXTRACT02
Production extractors (3 ut)	2.400	EXTRACT03
Production extractors (3 ut)	2.400	EXTRACT04
Production extractors (3 ut)	2.400	EXTRACT05
Production extractors (3 ut)	2.400	EXTRACT06
On control extractors relay	200	CONTROL VENTILATION

Table 1.6.22.1. Ventilation sub-panel power distribution (Source: Martí Domenech)

Total Driving Power (W)	**14.600**

Total Lighting Power (W)	
Total Power (W)	**14.600**

Table 1.6.22.2. Ventilation sub-panel abstract of power distribution (Source: Nil Domenech)

1.6.23. Sub-panel Lighting (SP-LIGHTING)

Description	Power (W)	Panel Line
LED lighting	1.880	LT01
LED lighting	1.880	LT02
LED lighting	1.880	LT03
LED lighting	940	LT04
LED lighting	1.385	LT05
LED lighting	222	LT06
LED lighting	1.504	LT07
LED lighting	1.504	LT08
LED lighting	1.504	LT09
LED lighting	752	LT10
LED lighting	762	LT11
LED lighting	1.397	LT12
LED lighting	1.397	LT13
LED lighting	376	LT14
Warehouse emergency	150	EMERGENCY01
Production emergency	150	EMERGENCY02

DALI management system	2.000	DALI

Table 1.6.23.1. Lighting sub-panel power distribution (Source: Martí Domenech)

Total Driving Power (W)	**2.000**
Total Lighting Power (W)	**17.683**
Total Power (W)	**19.683**

Table 1.6.23.2. Lighting sub-panel abstract of power distribution (Source: Nil Domenech)

1.6.24. Sub-panel Dining room (SP-DINING)

Description	Power (W)	Panel Line
LED (9 ut)	279	LT01
Emergency lighting	50	EMERGENCY
Selling machine 01	1.500	SEM01
Selling machine 02	1.500	SEM02
Cleaning plugs	600	CPLUGS
Automatic door dining room	600	DOOR

Table 1.6.24.1. Dining sub-panel power distribution (Source: Martí Domenech)

Total Driving Power (W)	**4.200**
Total Lighting Power (W)	**329**
Total Power (W)	**4.529**

Table 1.6.24.2. Dining sub-panel abstract of power distribution (Source: Nil Domenech)

1.6.25. Sub-panel Dye (SP-DYE)

Description	Power (W)	Panel Line

Dye dispenser	300	DISP01
Dye agitator	750	AGI01
Dye room compressor	2.400	COM01
Air conditioning	1.500	AIR01
Drum lift	367	LIFT01
Drum agitator	367	AGI02
Services box	2.000	SERBOX
Watertight screens purifying plant (12 ut)	863	LT01
Watertight screens purifying plant (12 ut)	863	LT02
Watertight screens purifying plant (12 ut)	863	LT03
Emergency lighting	50	EMERGENCY
Backup 1	1	BACKUP01
Backup 2	1	BACKUP02

Table 1.6.25.1. Dye sub-panel power distribution (Source: Martí Domenech)

Total Driving Power (W)	**7.686**
Total Lighting Power (W)	**2.642**
Total Power (W)	**10.328**

Table 1.6.25.2. Dye sub-panel abstract of power distribution (Source: Nil Domenech)

1.7. ELECTRICAL CONNECTION

Is the part of the installation of the distribution network that feeds the general protection box (CGP). The conductors will be aluminium or copper and will be regulated by the ITC-BT-11.

According to the layout of the line, the installation system and the characteristics of the network, the electrical connection will be:

- Underground. The conductors will be isolated, assigned voltage 0,6/1kV, and they can be installed directly undergrounded, buried under tube or galleries, sewers or channels revisable.

In this case, it is an electrical supply through a private transformation station with a 630 kVA transformer, being the electrical connection part of the transformation station installation. It will be a line of 0,3 meters of aluminium RZ1-Al (AS) of 4(4x240)mm^{2}Al, designed voltage 0,6/1 kV.

1.8. LINK INSTALLATION

1.8.1. General Protection Box, Measuring Equipment and Individual Derivation

In the case of electric supplies to a single user, the absence of general line of supply, the general Protection Box (CGP) will be placed into a single element with the measurement equipment. This element will be called Protection and Measurement Box (CPM). Consequently, the protection fuse located in before the counter, will be the same that the fuse that protects the Protection and Measurement Box (CPM).

It will be installed in the outdoor walls of the building, in places of permanent access. The location will be determined by mutual agreement between the property and the electrical supply company.

The Individual Derivation is the part of the installation that, since the Protection and Measurement Box, to the user installation, supply the electric power. It includes the safety fuses, all measuring devices and the general control and protection. It is regulated by the ITC-BT-15.

The Individual Derivation comprises:

- Isolated conductors inside tubes undergrounded.
- Isolated conductors inside tubes in surface mount.
- Isolated conductors inside a protector channel, with cover that only can be opened with a tool.
- Channeling bus bar prefabricated that meets the norm UNE-EN60.439-2.
- Isolated conductors within ducts closed brickwork, designed and built for that purpose.

The conductors to be used will be of cooper or aluminium, isolated and preferentially unipolar. The designed voltage should be 450/750V minimum. If the cables have more than one pole, or if the Individual Derivation is inside undergrounded tubes, the designed voltage will be 0,6/1 kV. The

minimum section is 10 mm^2 for the pole conductors, the neutral and the protection, and 1,5 mm^2 to the switching line, and the last one have to be red.

The cables will not propagate the fire and will have a reduced smoke emission. The characteristics of the cables have to be equal with the norm UNE 21.123 part 4 or 5; or the norm UNE 211003 (depending on the designed voltage of the cable).

The maximum fall of voltage will be, in this case, lower than 1,5%.

The Individual Derivation, for isolated conductors inside tubes undergrounded, will comply with ITC-BT-07 for undergrounded networks. The cables will be placed in a buried canalization under tube, with a minimum depth of 0,6 m from the ground level, measuring since the lower part of the tube.

It will not install more than one circuit per tube, and the diameter of the tubes should allow easy lodging and removal of the cables. The outer diameter of the tubes will be obtained from the Table 9 of ITC-BT21.

The protector tubes shall comply with the provisions of the norm UNE-EN 50.086 2-4. The minimum characteristics will be:

- Compressive strength: 250N for tubes buried in concrete; 450N for tubes in light land; 750N for tubes in heavy land.
- Impact resistance: Light level for tubes buried in concrete; normal level for tubes in light ang heavy land.
- Resistance against penetration of solid objects: Protected against objects D>1 mm.
- Resistance against penetration of water: Protected against rain water.
- Corrosion resistance of metal and composite tubes: Indoor and outdoor medium protection.

In this case, it is an electrical supply through a private transformation station with a 630 kVA transformer, being this elements part of this installation. The CPM will be a TMF-10/OLN1600. It includes a sectioning unit, a functional unit of measurement transformers 1000/5, a unit of checking and measurement multifunctional, a power control switch (ICP) of 1000 A regulated at 800 A and a functional protection unit of fuses of "pont amovible" 1000 A. The section of the measurement conductors will be (according to Vademecum) 100x10+50x10mm^2Cu.

1.8.2. General and individual control and protection devices

The general control and protection devices shall be situated as close as possible to the enter point of the Individual Derivation. In establishments as necessary, will be placed a box for the power control

switch, just before the other devices, in an independent and sealable compartment. This box can be placed in the same panel as the general control and protection devices.

The individual control and protection devices of all the circuits of the indoor installation, can be placed in separate panels and in different places.

The height where the general and individual control and protection devices will be placed, measured from the ground level, will be between 1 and 2 meters.

The surround of the panels will comply the norm UNE 20.451 and UNE-EN 60.439-3, with a minimum protection level IP 30 according to UNE 20.324 and IK 07 according to UNE-EN 50.102. What surround the power control switch will be sealable and the dimensions will complain with the selected electric tariff.

In this case, the protections will be:

1.8.2.1. IGA

This switch protect the General Power Line (LGA), with a maximum current of 910A. It will be an Automatic switch: I=1.000 A Reg. 0,9→I_r= 900 A, located in the general panel of control and protection (GPCP), as header switch.

1.8.2.2. Differential Switch Relation

Description	Class	I (A)	Sesnsibility (mA)	Quantity
2P Diff. Switch	AC	25	30	15
2P Diff. Switch	AC	25	300	8
2P Diff. Switch	AC	40	30	21
2P Diff. Switch	AC	40	300	8
2P Diff. Switch	AC “si”	40	30	4
2P Diff. Switch	AC	63	30	9
4P Diff. Switch	AC	25	30	23
4P Diff. Switch	AC	25	300	15
4P Diff. Switch	AC	40	30	22
4P Diff. Switch	AC	40	300	4
4P Diff. Switch	AC [s]	40	300	4
4P Diff. Switch	AC	63	30	12
4P Diff. Switch	AC	63	300	6
4P Diff. Switch	AC [s]	63	300	4
Realy and transf.	AC [s]	100	300	7
Realy and transf.	AC	100	300	1
Realy and transf.	AC [s]	125	300	3

Realy and transf.	AC [s]	160	300	2
Realy and transf.	AC [s]	250	300	2
Realy and transf.	AC [s]	400	300	2
Realy and transf.	AC [s]	630	300	1
Realy and transf.	AC [s]	1.000	300	1
Realy and transf.	AC [s]	1.000	500	1

Table 1.8.2.1. Differential switch relation (Source: Nil Domenech)

1.8.2.3. Magnetothermic Switch Relation

Description	I (A)	Quantity
2P Magnetothermic Switch	10	40
2P Magnetothermic Switch	16	77
2P Magnetothermic Switch	32	2
2P Magnetothermic Switch	63	2
4P Magnetothermic Switch	6	1
4P Magnetothermic Switch	16	86
4P Magnetothermic Switch	20	1
4P Magnetothermic Switch	25	5
4P Magnetothermic Switch	32	3
4P Magnetothermic Switch	40	14
4P Magnetothermic Switch	50	4
4P Magnetothermic Switch	63	22
3P Aut. Switch	1.000	1
4P Aut. Switch	1.000	2
4P Aut. Switch	630	1
4P Aut. Switch	400	4
4P Aut. Switch	250	2
4P Aut. Switch	160	5
4P Aut. Switch	125	7
4P Aut. Switch	100	11

Table 1.8.2.2. Magnetothermic switch relation (Source: Nil Domenech)

1.9. INDOOR INSTALLATIONS

The realization of this installation must be subject to the specifications of this project and the current Low Voltage Electrical Regulation and the Complementary Technical instructions.

1.9.1. General Prescriptions

1.9.1.1. Conductors

The conductors and the cables used in this installation will be cooper and always isolated. The assigned voltage will be upper than 450/750 V. The section of the used cables will be determined so that the voltage fall will be less than 3% for lighting and less than 5% for the other uses. Summing the maximum voltage fall of the Individual Derivation (1,5%), the total voltage fall must be less than 4,5% for lighting and less than 6,5% for the rest of the uses. In our case, the Indoor Installation start at the exit of the transformer.

This indoor installations, due to harmonic currents, the neutral conductor will be the same as the phase conductors, and never will be used in more than one circuit.

The maximum admissible current, will be that indicate the norm UNE 20.460-5-523 and the National annex.

The protection conductors will be:

- If phase section is equal or lower to 16 mm^2, the protection conductor will be equal to the phase conductor.
- If phase section is upper than 16 mm^2 and equal or lower than 35 mm^2, the protection conductor will be 16 mm^2.
- For Phase section upper than 35 mm^2 the protection conductor will be the half part of the phase conductor.

1.9.1.2. Identification of the conductors

The conductors of the installation must be easily identifiable, especially the neutral and protection conductors. The isolation colour will be the identifier. The neutral will be light blue, the protection will be green and yellow, and the phase conductors will be one brown, the other black and the third grey.

1.9.1.3. Subdivision of the installations

The installations will be subdivided to prevent for a possible damage caused in one line not affecting all others. The protection devices will be well coordinated and will be selective with the general devices that precede it.

All the installation will be divided in many lines, according to the needs with de purpose of:

- Avoid unnecessary interruptions and reduce the consequence of an error.
- Facilitate repairs and actions on the lines.

1.9.1.4. Load balancing

It shall be ensured that the loads will be divided equally in the three phases.

1.9.1.5. Insulation resistance and dielectric rigidity

The installation will have an insulation resistance equal or greater than:

Nominal voltage of the installation	Test voltage on DC (V)	Insulation resistance (MΩ)
MBTS or MBTP	250	0,25
< 500 V	500	0,5
> 500 V	1.000	1

Table 1.9.1.5. Minimum insulation voltage (Source: ITC-BT-19)

The dielectric rigidity, when the devices will be disconnected, will resist 1 minute a test voltage of 2U + 1000 V (in our case, U=400 V).

The leakage currents, will be lower than the sensibility of the differential devices.

1.9.1.6. Connections

The conductor union with connection or derivations for twisting will be forbidden. Always it will use connection terminals or terminal strips. The use of connecting flanges is permitted, but will always be done within splice boxes.

1.9.1.7. Installation systems: General prescriptions

Several circuits can circulate in the same canalization or tube if the isolation of the conductor is the correct.

In the case of electric canalizations near other non-electric, the external surfaces will be separated more than 3 cm. in the case of proximity with hot tubes or canalizations, the electric canalization will be separated in a distance nor dangerous. If the space is not enough, it will use heat shields.

If the insulation is not prepared to resist water, will not be under water or steam tubes or canalizations.

The canalizations will be installed in such a way that they are easily accessible, inspection and maneuver.

1.9.1.8. Installation systems: Isolated conductors under protector tubes

The designed voltage of the used cables will be greater than 450/750 V. The minimum outer diameter of the tubes, according to the number and section of the conductors, will be obtained of the ITC-BT-21, as well as the minimum characteristics according to the installation.

1.9.1.9. Installation systems: Canalizations under protector tubes

For the execution of the canalizations under protector tubes, we will do:

- The layout of the canalizations will be made with vertical and horizontal lines parallel to the walls of the installation.
- The connection of the tubes will be using appropriate accessories to their class, in order to ensure the protection of the conductors.
- The curves made by the tubes will not create inadmissible section reductions. The minimum curve radius for each class of tube is specified by the manufacturer according to the UNE-EN.
- The introduction and removal of conductors in tubes should be easy, with no more than 15 meters between registers, used it for the introduction of the conductors, or as junction box.
- The connections between conductors shall be made in appropriate boxes of insulating material and no flame propagation. If the boxes are metallic, they will be protected against corrosion. The dimensions of this boxes will be bigger than all the conductors. The depth of the box shall be at least 1,5 times the diameter of the greatest tube, the minimum being 40 mm.
- In tubes without internal insulation, the possibility of condensation of water will be taken in account, so ventilation will be contemplated with opening at certain points of the tube.
- In accessible metallic tubes, will have ground. The electrical continuity must be ensured. If the tubes are flexible, grounding should not exceed 10 meters.
- It must not be used metallic tubes as protection or neutral conductors.

1.9.1.10. Installation systems: Tubes in surface installation

When the tubes will be installed in surface, it will be taken in account:

- The tubes shall be fixed to the walls or ceilings with flanges or clamps protected against corrosion. The distance between this elements will not exceed 0,5 meters. Fixations shall be provided on changes of direction, on the splices and in the vicinity of the boxes.

- In straight alignment, the deviation of the axis of the tube from the line joining the end points shall not be greater than 2%.

1.9.1.11. Installation systems: Tubes built-in

When the tubes are built-in, it will be taken in account:

- In the installation of tubes inside the building elements, the walls and ceilings safety will not be jeopardized.
- There will not be installed tubes destined to the lower plant between the floor and the cladding.
- For the installation of the same plant, only tubes that need to be covered with layer of concrete or mortar 1 cm thick.
- In the direction changes, the tubes will be conveniently curved or will have a T or elbows with registration caps.
- The registration caps will be accessible. It will be flush with the outer surface.

1.9.1.12. Installation systems: Underground isolated conductors

The conditions in this canalizations, the conductors will have to go under tube, except when they have cap and 0,6/1 kV designed voltage, which will be according the ITC-BT-07 and ITC-BT-21.

1.9.1.13. Installation systems: Isolated conductors in protected canalization

The protected canalization is an installation material constituted by a profile of perforated walls or not perforated walls, intended to house conductors or cables and closed by a cover.

The protection level of the canalizations will be IP4X and will be classified as ”canalization with cover can only be opened with tool”. Inside, can be installed mechanisms like switches, outlets and control devices. Can also be done splices of conductors in the interior.

According to the place where the canalization is installed, it will need characteristics like temperature resistance, impact resistance, etc. according to UNE-EN50.085.

If the canalization is electric conductor, will be grounded.

The cover of the canalizations will always be accessible.

1.9.1.14. Installation systems: Insulated conductors in tray

It will only be used insulated conductors with cover, of one or more poles, according to norm UNE-20.460-5-52.

1.9.2. Installations in specific characteristics locals: Installation in a local with bath or shower

1.9.2.1. Volume classification

- Volume 0
  Comprises the interior of the bath or shower.
  In a shower without a plate, this volume is delimited by the ground and the horizontal plane located 5 cm above the ground.
    - If the shower diffuser can be moved during the use, the volume 0 is limited by the vertical plane located at a radius of 1,2 m around the water outlet wall or the vertical plane that closes the occupied area by the person being showered.
    - If the shower diffuser is fix, the volume 0 is limited by the vertical plane located at a radius of 0,6 m around the diffuser.
- Volume 1
  Is limited by:
    - The upper horizontal plane in volume 0 and the horizontal plane located at 2,25 m.
    - The vertical plane of the bath or shower that includes a space under it, when this space is accessible without a tool. Or for a shower without plate with mobile diffuser. The volume 1 is limited by the vertical plane located at a radius of 1,2 m around the water outlet wall or the vertical plane that closes the occupied area by the person being showered. Or by a shower without plate and with fix diffuser, the volume 1 is limited by the vertical plane located at a radius of 0,6 m around the diffuser.
- Volume 2
  Is limited by:
    - The outdoor vertical plane of the volume 1 and the vertical plane parallel located at a distance of 0,6 m.
    - The floor and the horizontal plane located at 2,25 m above the floor.

  In addition, when the height of the ceiling is greater than 2,25 m above the floor, the space between volume 1 and ceiling or up to a height of 3 m above floor, anyone is considered volume 2.
- Volume 3
  Is limited by:

- The outdoor vertical plane of the volume 2 and the parallel plane located at a distance of 2,4 m.
- The floor and the horizontal plane located at 2,25 m above the floor.

In addition, when the height of the ceiling is greater than 2,25 m above the floor, the space between the volume 2 and the ceiling or up to a height of 3 m above the floor, anyone less value is volume 3.

The volume 3 includes any space below the bath or shower that can be only accessible with a tool with a minimum protection IP X 4. This classification is not applicable to the space located under a hydromassage bathtub and or hydromassage cabin.

1.9.2.2. Choice and installation of electrical materials

- Volume 0
  - Protection level: IPX7.
  - Cabling: The necessary to feed the fixed electric devices located in this volume.
  - Mechanisms: Not allowed.
  - Another fixed devices: Devices that only can be installed in volume 0 and must be located to the conditions of this volume.
- Volume 1
  - Protection level: IPX4.
  - Cabling: The necessary to feed the fixed electric devices located in volume 0 and 1.
  - Mechanisms: Not allowed, excepting switches of circuits MBTS feed on 12 V AC or 30 V DC. In DC, the power supply shall be installed out of volumes 0, 1 and 2.
  - Another fixed devices: Devices feed on MBTS not greater than 12 V AC or 30 V DC. Water heaters, shower pumps and electronic equipment for hydromassage bathtub that complain with the applicable norms, protected with a differential switch with less than 30mA according to UNE 20.460-4-41.
- Volume 2
  - Protection level: IPX4.
  - Cabling: The necessary to feed the fixed electric devices located in volume 0, 1, 2 and the part of volume 3 located below the bath or shower.
  - Mechanisms: Not allowed, excepting switches of circuits MBTS feed on 12 V AC or 30 V DC. In DC, the power supply shall be installed out of volumes 0, 1 and 2. Also, is allowed the installation of razor power packs that complain UNE-EN 60.742 or UNE-EN 61558-2-5.
  - Another fixed devices: All the allowed in volume 1.
- Volume 3
  - Protection level: IPX5, in common toilets, when water jets may occur during cleaning.

- Cabling: The necessary to feed the fixed electric devices located in volume 0, 1, 2 and 3.
- Mechanisms: Allowed only if it is well protected by an isolation transformer, or by MTBS, or by an automatic switch not greater than 30 mA, all of the according to UNE 20.460-4-41.
- Another fixed devices: Is only allowed if it is protected by an isolation transformer, or by MTBS, or by an automatic switch not greater than 30 mA, all of the according to UNE 20.460-4-41.

1.9.3. Installations in specific characteristics locals: Installation in a local with outdoor lighting

In this case, the outdoor lighting will be composed by lightening.

1.9.3.1. Power grid

- Underground grids:

  It will be used similar systems to the explained in the distribution grids regulated in ITC-BT-07. The cables will be undergrounded in a tube at a depth of 0,4 m of the floor level, measured from the lowest dimension of the tube. The tube diameter shall not be less than 60 mm.

  It will not be installed more than a circuit per tube. The outdoor tube diameter will depend on the section of the cables, according to ITC-BT-21 table 9.

  The protector tubes shall conform to the norm UNE-EN 50.086 2-4. The minimum characteristics will be:

  - Compression resistance: 250 N for tubes in concrete; 450 N For tubes in light floor; 750 N for tubes in heavy floor.
  - Impact resistance: Light grade for tubes in concrete; Normal grade for tubes in light and heavy floor.
  - Resistance to penetration of solid objects: Protected against objects D>1 mm.
  - Resistance against water penetration: Protected against the rain.
  - Resistance against corrosion: Indoor and outdoor medium protection.

  A signalling tape will be placed at a distance of between 0,1 and 0,25 m of the tube to advise of the existence of outdoor lighting cables.
  At the cross of roads, the canalization will go in a tube and concreted, and it will be installed a backup tube.

The minimum section to use in undergrounded grids, including the neuter, will be 6 mm^2. In three-phase four pole distributions, for phase conductors section greater than 6 mm^2, the neuter section will complain with the table 1 of ITC-BT-07. The derivations will be in suitable terminal boxes, located in the lighting supports, at a height of 0,3 m or in a chest, conveniently isolated.

- Control grid and auxiliary:
  It will be used systems and materials similar to the used in power grids, the minimum section shall be 2,5 mm^2.

1.9.3.2. Protection, measurement and control box

The lighting and control power grids, will start in the Protection and control panel. The lines will be individually protected, with homopolar cut, against overcurrent, ground fault and overvoltage (when it is necessary). The maximum fault current on differential switches will be 300 mA and the maximum grounding resistance will be 30 ohm. If the ground resistance is lower than 5 ohm, the current fault of the differential switches can be 500 mA, or 1 A if it is lower than 1 ohm.

If the lighting powering is commanded by a photoelectric device or a clock device, it will have a manual switch, independent of the other devices.

If the panel is located on the outdoor, the box protection will be grater or equal than IP55, according to UNEIX 20.324 and IK10 according to UNEIX-EN 50.10 and it will have only access to authorized personnel.

1.9.3.3. Lighting support

- Supports
  The supports of the outdoor lighting will complain the actual regulation. It will be of resistant materials, and will be protected against the weather, isolated against water. The safety coefficient for the mechanic efforts, will be 2,5, to be protected against the wind and other possible efforts.
- Conductors
  The feed of the lightings will be with designed voltage conductors 0,6/1 kV, of 2x2,5 mm^2 section and it will not exist splices.
  In the entrance to the supports, the conductors will have an extra protection with the tube or other systems.
  The connection will be made without traction efforts to the conductors.
  The feed lines of lights that could made harmonics, will be dimensioned for a 1,8 times the power of the lamp.

The maximum fall of tension will be less than 3%.

- Lightings
  The lighting will be according to UNE-EN 60.598-2-3 and the UNE 60.598-2-5 in the case of outdoor projectors.
  The connection will be made with flexible cables, feeding devices with a protection grade IP X 3 according to UNE 20.324.
  All the outdoor lighting points will have a power factor compensation equal or greater than 0,9.

1.9.3.4. Protection systems

The lighting will be class I or class II. When it will be class I, it will be grounded, with a one pole cable isolated with designed voltage 450/750 V, green-yellow and with minimum section 2,5 mm^2 Cu.

The accessible metallic parts, will be grounded. The lightings located at a less height than 3 m, it will be needed a special tool to open it.

1.9.3.5. Grounding

The grounding of the supports will be made by connection to the common grounding of all the installation lines that starts on the protection, measurement and control panel.

In the ground grids, it will be installed a ground electrode each five supports. And always in the first and the last support of every lines.

The protection conductor that connect the supports with the electrode or with the ground grid, will be a one pole cable insulated, with designed voltage 450/750 V, colour green-yellow and wit minimum section 16 mm^2 Cu.

The maximum fault current on differential switches will be 300 mA and the maximum grounding resistance will be 30 ohm. If the ground resistance is lower than 5 ohm, the current fault of the differential switches can be 500 mA, or 1 A if it is lower than 1 ohm.

In our case, the conductors used will have a designed voltage of 0,6/1 kV and all de conductors will be RZ1-K (AS). All the conductors are indicated in an resume at the end of this memory.

1.10. LIGHTING RECEPTORS AND ENGINES

1.10.1. Lighting

The lighting will be according to the norm UNE-ENN 60598.

The mass of suspended luminaries may not exceed 5 kg. The conductors must be able to support this weight, they must not have intermediate joints and the weight must be carried out on a other element tan the connecting borne.

The metallic parts of the luminaries other than class II or class III shall have a connection element for their grounding, which shall be reliably and permanently connected to the protector conductor of the circuit.

The power circuits will be designed to carry a power 1,8 times the nominal power of the lighting elements of the line. In case of one phase circuits (230 V in our case) the neuter section will be equal to the phase section. The minimum compensation power factor for the lighting will be 0,9.

1.10.2. Engine receptors

The engines have to be installed so that their moving parts cannot cause accidents.

The power conductors for one engine, have to be designed for the 125% current of full load. When it feed several engines, the power conductors will be designed for the full load current of all the engines plus the 125% full load current of the biggest engine.

Engines must be protected against short circuits and overloads in all phases. In the case of ignition star-delta engines, the protection will be ensured for both ignitions.

Engines must be protected against lack of tension by an automatic power cur-off device, in the event that the spontaneous ignition of the engine, as result of restoring the voltage, can cause accidents or damage the engine, according to UNE 20.460-4-45.

1.11. GROUNDING CALCULATION

Grounding is established to limit the voltage that metallic masses can present with respect to ground, to ensure the performance of protections and to reduce the risk of fault in the electrical materials used in the installation.

Grounding is the direct electrical connection, without protection, of a part of the electrical circuit or of a conducting part that does not belong to the electrical circuit, through a grounding with an electrode or a group of electrodes buried in the ground.

The installation of grounding should ensure that all installations, buildings and surfaces close to the terrain do not present dangerous potential differences and allow grounding of fault currents or atmospheric discharges.

The choice and installation of materials that ensure the grounding have to be:

- The value of grounding resistance have to be according with the standards of protection and operation of the installation and remains the same over time.
- Ground fault currents and leakage currents must be able to circulate safely, particularly from a thermal, mechanical and electrical point of view.
- The strength and mechanical protection must be ensured, regardless of external conditions and influences.

1.11.1. Ground connections

1.11.1.1. Grounding

For the grounding can be used electrodes formed by:

- Bars or tubes.
- Cooper plates or naked conductors.
- Rings or wire mesh.
- Buried concrete reinforcement.

The cooper conductors used like electrodes will have a resistance according to class 2 norm UNE 21.022.

The type and the depth of the grounding must be such that the possible loss of moisture, the presence of ice or other climatic defects, do not raise the resistance value above what is allowed.

The depth must be greater than 0,5 m.

1.11.1.2. Ground conductors

The section of ground conductors, when they are buried, must be according to the next values. The section will not be less than the minimum specified for protector conductors.

Type	Mechanically protected	Not mechanically protected
Protected against corrosion	Same as the protector conductors indicated in table 2 of section 3.4 of ITC-BT-18.	16 mm^2 Cu 16 mm^2 Galvanised steel
Not protected against corrosion	25 mm^2 Cu 50 mm^2 Fe	

Table 1.11.1.1. Ground conductors section (Source: ITC-BT-18)

During the execution of the joints between ground conductors and ground electrodes, extreme care must be taken to ensure that they are electrically correct. Make sure that the connections will not damage the conductors or the electrodes.

1.11.1.3. Grounding terminals

A main ground terminal must be provided in all the installation, to which the following conductors:

- Ground conductors.
- Protector conductors.
- Main equipotential union conductors.

An accessible device must be placed on the ground conductors to measure the ground resistance of the installation. It have to be mechanically safe and ensure the electrical continuity.

1.11.1.4. Protector conductors

The protector conductors are used to electrically connect the masses of an installation with the ground terminal, to ensure protection against indirect contacts.

The minimum section of the protector conductors will be according to table 2, of point 3.4 of the ITC-BT-18:

Conductors phase section (mm^2)	Protection conductors section (mm^2)
$S_f \leq 16$	S_f
$16 < S_f \leq 35$	16

S_f>35	$S_f/2$

Table 1.11.1.2. Protector conductors section (Source: ITC-BT-18)

In all the cases, the protective conductors that are not part of the feed will be of cooper with minimum section of:

- 2,5 mm^2, if the protection conductors have mechanic protection.
- 4 mm^2, if the protection conductors not have mechanic protection.

Can be used as protector conductor:

- A conductor of a multipolar cable.
- An isolated or naked conductor having common housing with the active conductors.
- Separated naked or isolated conductors.

No appliance should be inserted into the protective conductor. The masses of the equipment to be connected to the protective conductors must not be connected in series.

1.11.2. Equipotentiality conductors

The main equipotentiality conductor should not have a less section than the half section of the greatest protective conductor of the installation. The minimum is 6 mm^2, but if it is cooper it can have a 2,5 mm^2 section.

The supplemental equipotential union may be secured by non-dismountable conductor elements or by additional conductor, or both things.

1.11.3. Grounding elements resistance

The value of the resistance of ground will be any value that ensures that there will be no voltages greater than:

- 24 V in conductor locals.
- 50 V in the rest.

If the conditions of the installation are those that can give raise to contact voltages higher than these values, the speed of action of the protection elements must be ensured.

The resistance of an electrode depend on its dimensions, its shape and the resistivity of the ground where it is. This resistivity changes with the terrain and with the depth. The formula to calculate it is:

Electrode	Ground resistance (Ω)
Buried plate	$R = \frac{0{,}8 \cdot r}{p}$
Vertical spades	$R = \frac{r}{L}$
Buried conductor	$R = \frac{2 \cdot r}{L}$

Table 1.11.3.1. Electrode resistance (Source: ITC-BT-18)

Where:

- r: Terrain resistivity (Ωxm).
- p: Perimeter of the plate (m).
- L: Longitude of the spade or the conductor (m).

The calculation of the grounding is in the part of calculations.

We have choice 10 spades of 2 meters located around the edification, joined by a conductor of 100 meters of longitude. With a Terrain resistivity of 300 Ωxm the ground resistance obtained is 4.3 Ω.

1.12. SPECIAL PROTECTION

1.12.1. Protection against direct contacts

The active parts of the electric installations must be recovered by isolation that cannot be removed.

1.12.1.1. Protection by barriers or enclosures

The active parts must be located inside wrappings or behind barriers that have at least a protection IP XXB, according to UNE 20.324. If openings are required for the repair of parts or for proper functioning of the equipment, appropriate precautions shall be taken to prevent persons or domestic animals from touching the active parts and ensuring that persons are aware that the active parts should not be voluntarily touched.

The upper surfaces of horizontal barriers or envelopes which are easily accessible must meet at least a degree of protection IP4X or IPXXD.

Barriers or enclosures must be fixed safely and maintain the protection required despite external influences.

When it is necessary to remove the barriers or open the enclosures, it will only be possible with:

- The help of a key or tool, or;
- No voltage on the active parts, or;
- A second barrier with minimum protection IP2X or XXB.

1.12.1.2. Additional protection for differential-residual current devices

This protective measure is only intended to complement other measures of protection against direct contacts. The use of differential-residual current devices is used in prevent of recklessness ad the assigned voltage of this devices will be not greater than 30 mA.

1.12.2. Protection against indirect contacts

The protection against indirect contacts will be achieved by automatic cut of the feeding. This measure is to prevent the generation of contact voltage of more than 50 V AC and 24 V AC in humid places.

All the masses protected by the same device, must be connected by the same protection conductor of the same ground. The neuter of all the generator or transformer have to be grounded.

It will complain the next condition:

$$Ra \cdot Ia \leq U$$

Where:

- Ra is the sum of the grounding resistances and the conductors of mass protection.
- Ia is the current that ensures the function of the automatic protection device.
- U is the contact voltage, the limit is 50 V or 24 V, according to the place.

1.12.3. Protection against overcurrent

All the circuit must be protected against overcurrent. The interruption of the circuit will be carried out in a suitable time or it will be dimensioned for the expected overcurrent.

The overcurrent can succeed by:

- Overcharge by the devices or high impedance insulation faults.
- Short-circuits.
- Atmospheric electric shocks.

Protection against overcharge: The limit of maximum current that can flow through a conductor must be enforced by the protection device used. The protection device may be an automatic omnipolar cut-off switch or properly calibrated fuses.

Protection against short-circuits: At the origin of all the circuits there will be a protection device against short-circuits. Its cutting capacity will depend on the short-circuit current that can flow at the point of its connection. It is recognized that in the case of circuits derived from one main circuit, each of the circuits derived therefrom is provided with overload protection, so long as a single general device can provide protection against short-circuits. Automatic omnipolar cur-off switches and properly calibrated fuses are supported as short-circuit protection.

The norm UNE 20.460-4-43 covers all aspects required for protection devices. The norm UNE 20.460-4-473 defines the application of the protection measures set out in the norm 20.460-4-43 depending if it is for short-circuit or overload, indicating its location or omission.

1.12.4. Protection against overvoltage

1.12.4.1. Overvoltage categories

The categories indicate the voltage values supported by the equipment against the overvoltage, determining the maximum limit value of residual voltage that the different protection devices of each zone must allow to prevent the equipment from being damaged.

There are 4 categories, indicating in each case, the supported voltage by pulses, in kV, according to the nominal voltage of the installation.

Nominal voltage of the installation		**Supported voltage by pulses 1,2/50 (kV)**			
Three-phase	Monophasic	Category IV	Category III	Category II	Category I
230/400	230	6	4	2,5	1,5
400/690 **1000**	-	8	6	4	2,5

Table 1.12.4.1. Overvoltage categories (Source: ITC-BT-23)

Category I

It applies to equipment that is very sensitive to overvoltage and is intended to be connected to the fix electric installation (computers, sensitive electronic equipment, etc.). In this case, protective measures are taken outside the equipment to be protected, in order to limit the overvoltage to a specific level.

Category II

It applies to equipment intended to be connected to the fix electric installation (home appliances, portable tools and similar equipment).

Category III

It applies to equipment and materials that are part of the fix electric installation and to other equipment for which a high level of reliability is required (distribution panels, bus bars, switches, fixed engines, etc.).

Category IV

It applies to equipment and materials that is connected on the origin or close to the origin of the installation, up to the distribution panel (measurement equipment, principal equipment against overcurrent, etc.).

1.12.4.2. Measures for overvoltage control

It can be two situations:

- Natural situation: When there is no need for protection against transient surges, because is a low risk of overvoltage in the installation (it is feed by a whole underground grid). In this case the resistance of the equipment is considered enough and it is not necessary extra protection against overvoltage.
- Controlled situation: When the installation needs overvoltage protection in the origin of the installation, because the installation is feed by, or includes an air line with naked or insulated conductors.

It is also considered a controlled situation that normal situation where it is convenient to include devices to protect against overvoltage due to the value of equipment or irreplaceable losses.

Protection devices against overvoltage of atmospheric origin must be selected in such a way that their protection level is lower than the supported pulse of the category of the equipment and material installed.

In our case, will be installed one protection device against transitory overvoltage and other against permanent overvoltage, both located in general panel of control and protection.

1.12.4.3. Selection of materials in the installation

The equipment and materials must be selected so that their pulsed supported voltage is not less than the voltage supported in the previous table, according to their category.

The equipment and material that have a pulsed supported voltage less than the indicated in the previous table, will be used if:

- In natural situation, when risk is acceptable.
- In controlled situation, if the protection is acceptable.

1.13. RESUME OF LINES AND PROTECTIONS

Line	Panel	Voltage (V)	Distance (m)	Conductor sect.(mm^2)	Conductor	Power (W)	Diff. prot. (mA / A)		Mag. Prot. reg (A)
SWITCHBOARD	EPBT	230	15	2x1,5+TTx1,5	Cu	50	300 AC	25	10
LIGHT TS	EPBT	230	15	2x1,5+TTx1,5	Cu	64	300 AC	25	10
METER PLUG	EPBT	230	15	2x1,5+TTx1,5	Cu	500	300 AC	25	10
GDP	EPBT	400	10	4(4x240)	Al	1127964	500 AC		900
SP-WEATHER	GPCP	400	60	4x95+TTx50	Cu	67230,00	300 AC (s)		160
SP-COMP	GPCP	400	60	4x95+TTx50	Cu	102100,00	300 AC (s)		160
SP-WAREHOUSE	GPCP	400	150	4x95+TTx50	Cu	62995,00	300 AC (s)		100
SP-EMBA244	GPCP	400	140	4x240+ TTx120	Cu	133554,00	300 AC (s)		400
SP-EMBA170	GPCP	400	145	4x240+ TTx120	Cu	164750,00	300 AC (s)		400
SP-PROD1	GPCP	400	60	4x35+TTx16	Cu	57144,00	300 AC (s)		80
SP-WORKSHOP	GPCP	400	110	4x25+TTx16	Cu	10964,00	300 AC	63	63
SP-PROD2	GPCP	400	80	4x70+TTx35	Cu	57392,00	300 AC (s)		125
SP-BOBST	GPCP	400	100	4x70+TTx35	Cu	40936,00	300 AC (s)		125
SP-TRANSFER	GPCP	400	60	4x25+TTx16	Cu	25050,00	300 AC	63	63
SP-EXIT	GPCP	400	150	4x10+TTx10	Cu	2900,00	300 AC (s)	40	40
SP-SUCTION	GPCP	400	150	4x70+TTx35	Cu	52494,00	300 AC (s)		125
SP-TOILETS	GPCP	400	100	4x10+TTx10	Cu	10782,00	300 AC (s)	40	40
SP-OFFICES	GPCP	400	40	4x16+TTx16	Cu	26820,00	300 AC (s)	63	50
SP-INFORMATICS	GPCP	400	75	4x25+TTx16	Cu	21590,00	300 AC (s)	63	63
SP-FIREPROT	GPCP	400	90	4x25+TTx16	Cu	4838,00	300 AC (s)	63	63

SP-VENTILATION	GPCP	400	80	4x50+TTx25	Cu	14600,00	300 AC (s)		100
SP-LIGHTING	GPCP	400	90	4x25+TTx16	Cu	19683,00	300 AC (s)	63	63
SP-DINING	GPCP	400	75	4x25+TTx16	Cu	4529,00	300 AC (s)	40	20
SP-DYE	GPCP	400	125	4x10+TTx10	Cu	10328,00	300 AC (s)	40	40
SP-PUMP01	GPCP	400	100	4x240+TTx120	Cu	176000,00	300 AC		490
SP-PURIFICATION	GPCP	400	140	4x25+TTx16	Cu	11185,00	300 AC (s)		63
SP-ELE	GPCP	400	115	4x25+TTx16	Cu	25000,00	300 AC	63	63
CAPACITOR BANK	GPCP	400	10	4(3x180+ TTx95)	Cu	264,12 kVAr	300 AC		800
	GPCP	400							900
CP-GEOTHERMAL	SP-WEATHER	400	15	4x35+TTx16	Cu	50000,00	300 AC (s)		100
Gas boiler	SP-WEATHER	400	12	4x2,5+TTx2,5	Cu	940	300 AC	25	16
LT-01	SP-WEATHER	230	15	2x1,5+TTx1,5	Cu	320	300 AC	25	10
EMERGENCY	SP-WEATHER	230	15	2x1,5+TTx1,5	Cu	50			10
OFFICES PUMP	SP-WEATHER	400	114	4x2,5+TTx2,5	Cu	80	300 AC	63	16
DRESSING ROOM PUMP	SP-WEATHER	400	112	4x2,5+TTx2,5	Cu	110			16
ACS PUMP	SP-WEATHER	400	13	4x2,5+TTx2,5	Cu	110			16
AIRCOND	SP-WEATHER	400	20	4x6+TTx6	Cu	10.000	300 AC	25	25
Factory pump	SP-WEATHER	400	14	4x2,5+TTx2,5	Cu	1.810	300 AC	40	16
Warehouse pump	SP-WEATHER	400	15	4x2,5+TTx2,5	Cu	1.810			16
CONTROLPUMPS	SP-WEATHER	400	14	4x2,5+TTx2,5	Cu	2.000	300 AC	25	16
	SP-WEATHER	400							160
COM01	SP-COMP	400	25	4x35+TTx16	Cu	30.000	300 AC (s)		100
COM03	SP-COMP	400	25	4x35+TTx16	Cu	30.000	300 AC (s)		100
DRY01	SP-COMP	400	15	4x2,5+TTx2,5	Cu	300	300 AC	25	16
LT01	SP-COMP	230	15	2x1,5+TTx1,5	Cu	250	30 AC	25	10

EMERGENCY	SP-COMP	230	15	2x1,5+TTx1,5	Cu	50			10
COM02	SP-COMP	400	20	4x16+TTx16	Cu	15.000	300 AC	63	63
SUCTION	SP-COMP	400	50	4x16+TTx16	Cu	15.500	300 AC	40	32
PLUG01	SP-COMP	400	25	4x2,5+TTx2,5	Cu	2.500	30 AC	25	16
SERVICE BOXES	SP-COMP	400	15	4x2,5+TTx2,5	Cu	3.000	30 AC	40	40
SW V P	SP-COMP	400	20	4x2,5+TTx2,5	Cu	5.500	300 AC	25	16
	SP-COMP	400							160
CBA01	SP-WAREHOUSE	230	18	2x2,5+TTx2,5	Cu	1.000	30 AC	40	16
CBA02	SP-WAREHOUSE	230	19	2x2,5+TTx2,5	Cu	1.000			16
CBA03	SP-WAREHOUSE	400	22	4x4+TTx4	Cu	7.000	30 AC	63	16
CBA04	SP-WAREHOUSE	400	22	4x10+TTx10	Cu	20.000			40
DOOR01	SP-WAREHOUSE	400	56	4x2,5+TTx2,5	Cu	1.104	30 AC	40	16
DOOR02	SP-WAREHOUSE	400	54	4x2,5+TTx2,5	Cu	1.472			16
DOOR03	SP-WAREHOUSE	400	54	4x2,5+TTx2,5	Cu	1.235	30 AC	40	16
DOOR04	SP-WAREHOUSE	400	55	4x2,5+TTx2,5	Cu	1.500			16
LP01	SP-WAREHOUSE	400	55	4x2,5+TTx2,5	Cu	2.944	30 AC	40	16
LP02	SP-WAREHOUSE	400	55	4x2,5+TTx2,5	Cu	2.944			16
AER01	SP-WAREHOUSE	400	35	4x2,5+TTx2,5	Cu	1.360	30 AC	63	16

AER02	SP-WAREHOUSE	400	36	4x2,5+TTx2,5	Cu	700			16
AER03	SP-WAREHOUSE	400	37	4x2,5+TTx2,5	Cu	700			16
SB	SP-WAREHOUSE	400	32	4x10+TTx10	Cu	4.500	30 AC	25	16
SP-LOGOFI	SP-WAREHOUSE	400	20	4x6+TTx6	Cu	9.660			25
BRIDGE	SP-WAREHOUSE	400	50	4x10+TTx10	Cu	5.875	30 AC	40	40
BACKUP	SP-WAREHOUSE	400	8	4x2,5+TTx2,5	Cu	0	30 AC	25	16
	SP-WAREHOUSE	400							125
LT01	SP-OFILOG	230	15	2x1,5+TTx1,5	Cu	595	30 AC	40	10
EMERGENCY	SP-OFILOG	230	15	2x1,5+TTx1,5	Cu	65			10
PLUGS 01	SP-OFILOG	230	15	2x2,5+TTx2,5	Cu	1.500	30 AC	40	10
PLUGS 02	SP-OFILOG	230	15	2x2,5+TTx2,5	Cu	1.500			10
PLUGS 03	SP-OFILOG	230	15	2x2,5+TTx2,5	Cu	1.500			10
PLUGS 04	SP-OFILOG	230	15	2x2,5+TTx2,5	Cu	1.500	30 AC	40	10
CLI01	SP-OFILOG	230	15	2x2,5+TTx2,5	Cu	1.500			10
CLI02	SP-OFILOG	230	15	2x2,5+TTx2,5	Cu	1.500			10
	SP-OFFILOG	400							63
BCR01	SP-EMBA244	400	20	4x95+TTx50	Cu	95.000 W	300 AC (s)		200
TIER01	SP-EMBA244	400	15	4x2,5+TTx2,5	Cu	4.000 W	30 AC	40	16
CCM01	SP-EMBA244	400	15	4x2,5+TTx2,5	Cu	5.500 W			16
PALLMAC	SP-EMBA244	400	18	4x16+TTx16	Cu	7.374 W	30 AC	63	50
GH01	SP-EMBA244	400	12	4x2,5+TTx2,5	Cu	736 W	30 AC	63	16
CHAIN01	SP-EMBA244	400	15	4x2,5+TTx2,5	Cu	552 W			16

CHAIN02	SP-EMBA244	400	18	4x2,5+TTx2,5	Cu	552 W			16
DIS01	SP-EMBA244	400	18	4x2,5+TTx2,5	Cu	736 W	30 AC	63	16
ROLL01	SP-EMBA244	400	18	4x2,5+TTx2,5	Cu	552 W			16
ROLL02	SP-EMBA244	400	18	4x2,5+TTx2,5	Cu	552 W			16
FEEDER	SP-EMBA244	400	19	4x10+TTx10	Cu	18.000 W	30 AC	40	40
	SP-EMBA244	400							400
BCR01	SP-EMBA170	400	20	4x95+TTx50	Cu	105.000	300 AC (s)		226
ELEVATOR	SP-EMBA170	400	25	4x2,5+TTx2,5	Cu	1.500	30 AC	40	16
TIER01	SP-EMBA170	400	30	4x2,5+TTx2,5	Cu	4.000			16
ROBOT	SP-EMBA170	400	18	4x16+TTx16	Cu	25.000	30 AC	63	50
HYDELEVATOR01	SP-EMBA170	400	12	4x2,5+TTx2,5	Cu	750	30 AC	63	16
ROLL01	SP-EMBA170	400	15	4x2,5+TTx2,5	Cu	2.250			16
HYDELEVATOR02	SP-EMBA170	400	18	4x2,5+TTx2,5	Cu	1500			16
FEEDER	SP-EMBA170	400	19	4x10+TTx10	Cu	18.000	30 AC	40	40
ROLL02	SP-EMBA170	400	20	4x2,5+TTx2,5	Cu	2.250	30 AC	63	16
ROLL03	SP-EMBA170	400	20	4x2,5+TTx2,5	Cu	2.250			16
ROLL04	SP-EMBA170	400	20	4x2,5+TTx2,5	Cu	2.250			16
	SP-EMBA170	400							400
STR01	SP-PROD1	400	15	4x6+TTx6	Cu	9.400	30 AC	25	25
STR02	SP-PROD1	400	20	4x6+TTx6	Cu	9.400	30 AC	25	25
BALER01	SP-PROD1	400	30	4x2,5+TTx2,5	Cu	5.250	30 AC	25	16
BALER02	SP-PROD1	400	25	4x2,5+TTx2,5	Cu	5.250	30 AC	25	16
SEM01	SP-PROD1	400	30	4x2,5+TTx2,5	Cu	500	30 AC	25	16
BIMA01	SP-PROD1	400	40	4x2,5+TTx2,5	Cu	5.250	30 AC	25	16
PAMA01	SP-PROD1	400	30	4x2,5+TTx2,5	Cu	2.944	30 AC	25	16
EBR01	SP-PROD1	400	25	4x2,5+TTx2,5	Cu	1.200	30 AC	25	16
ROLL01	SP-PROD1	400	15	4x2,5+TTx2,5	Cu	5.150	30 AC	25	16

ROLL02	SP-PROD1	400	15	4x2,5+TTx2,5	Cu	5.150	30 AC	25	16
ROLL03	SP-PROD1	400	15	4x2,5+TTx2,5	Cu	5.150	30 AC	25	16
TRIFASIC PLUGS	SP-PROD1	400	30	4x10+TTx10	Cu	2.500	30 AC	40	40
	SP-PROD1	400							160
LT01	SP-WORKSHOP	230	20	2x1,5+TTx1,5	Cu	1.104	30 AC	40	10
PLUGS	SP-WORKSHOP	230	20	2x1,5+TTx1,5	Cu	650			10
EMERGENCY	SP-WORKSHOP	230	20	2x1,5+TTx1,5	Cu	50			10
SERVICEBOX01	SP-WORKSHOP	400	15	4x10+TTx10	Cu	3.000	30 AC	40	40
SERVICEBOX02	SP-WORKSHOP	400	20	4x10+TTx10	Cu	3.000	30 AC	40	40
SERVICEBOX03	SP-WORKSHOP	400	25	4x10+TTx10	Cu	3.000	30 AC	40	40
AER01	SP-WORKSHOP	400	15	4x2,5+TTx2,5	Cu	160	30 AC	25	6
	SP-WORKSHOP	400							63
DC01	SP-PROD2	400	25	4x2,5+TTx2,5	Cu	2.944	30 AC	25	16
DC02	SP-PROD2	400	50	4x2,5+TTx2,5	Cu	22.080	30 AC	63	50
ST01	SP-PROD2	400	35	4x2,5+TTx2,5	Cu	1.472	30 AC	25	16
SHEAR01	SP-PROD2	230	30	2x2,5+TTx2,5	Cu	2.208	300 AC	25	16
SM01	SP-PROD2	230	30	2x2,5+TTx2,5	Cu	2.208	300 AC	25	16
CR01	SP-PROD2	400	35	4x6+TTx6	Cu	10.000	30 AC	40	32
CR02	SP-PROD2	400	25	4x6+TTx6	Cu	10.000	30 AC	40	32
PLUGS	SP-PROD2	230	25	2x2,5+TTx2,5	Cu	2.500	30 AC	25	16
DOOR01	SP-PROD2	400	46	4x2,5+TTx2,5	Cu	1.500	30 AC	40	16

DOOR02	SP-PROD2	400	60	4x2,5+TTx2,5	Cu	1.880			16
DOOR03	SP-PROD2	230	50	2x2,5+TTx2,5	Cu	600	30 AC	25	16
	SP-PROD2	400							125
DC01	SP-BOBST	400	20	4x25+TTx25	Cu	33.500	300 AC	63	63
PE01	SP-BOBST	400	32	4x2,5+TTx2,5	Cu	736	30 AC	40	16
ROLLER	SP-BOBST	400	25	4x2,5+TTx2,5	Cu	5.500			16
PLUGS	SP-BOBST	400	25	4x2,5+TTx2,5	Cu	450	30 AC	25	16
LT01	SP-BOBST	230	25	2x1,5+TTx1,5	Cu	750	30 AC	25	10
	SP-BOBST	400							125
ROLLER04	SP-TRANSFER	400	35	4x2,5+TTx2,5	Cu	2.250	30 AC	40	16
ROLLER05	SP-TRANSFER	400	38	4x2,5+TTx2,5	Cu	2.250			16
TRA01	SP-TRANSFER	400	25	4x2,5+TTx2,5	Cu	4.000	30 AC	63	16
TRA02	SP-TRANSFER	400	30	4x2,5+TTx2,5	Cu	750			16
TRA03	SP-TRANSFER	400	32	4x2,5+TTx2,5	Cu	750			16
TRA04	SP-TRANSFER	400	35	4x2,5+TTx2,5	Cu	750	30 AC	63	16
CAR01	SP-TRANSFER	400	35	4x2,5+TTx2,5	Cu	5.500			16
CAR02	SP-TRANSFER	400	32	4x2,5+TTx2,5	Cu	1.300			16
ROLLER01	SP-TRANSFER	400	25	4x2,5+TTx2,5	Cu	2.250	30 AC	63	16
ROLLER02	SP-TRANSFER	400	30	4x2,5+TTx2,5	Cu	2.250			16
ROLLER03	SP-TRANSFER	400	32	4x2,5+TTx2,5	Cu	3.000			16
	SP-TRANSFER	400							63
DOOR01	SP-EXT	400	35	4x2,5+TTx2,5	Cu	1.840	30 AC	25	16
DOOR02	SP-EXT	400	34	4x2,5+TTx2,5	Cu	1.060	30 AC	25	16
BACKUP	SP-EXT	400	6	4x2,5+TTx2,5	Cu	1 W	30 AC	25	16
	SP-EXT	400							63
SP-SUC-VENT	SP-SUCTION	400	100	4x35+TTx16	Cu	37.022 W			100
FTM1500	SP-SUCTION	400	15	4x10+TTx10	Cu	15.000 W	30 AC	40	40

VAL-VEOLAR1500	SP-SUCTION	230	20	2x2,5+TTx2,5	Cu	200 W	300 AC	40	16
SWITCHBOARD	SP-SUCTION	230	15	2x2,5+TTx2,5	Cu	20 W			10
PLC	SP-SUCTION	230	10	2x4+TTx4	Cu	200 W	300 AC	40	10
SIGNAL 24V	SP-SUCTION	230	15	2x4+TTx4	Cu	50 W			10
BACKUP	SP-SUCTION	230	10	2x2,5+TTx2,5	Cu	1 W	300 AC	40	16
BACKUP	SP-SUCTION	400	10	4x2,5+TTx2,5	Cu	1 W	300 AC	40	16
	SP-SUCTION	400							125
CUT	SP-SUC-VENT	400	20	4x35+TTx16	Cu	37.000	300 AC		100
SWITCHBOARD	SP-SUC-VENT	230	15	2x2,5+TTx2,5	Cu	20	300 AC	25	10
BACKUP	SP-SUC-VENT	230	10	2x2,5+TTx2,5	Cu	1	300 AC	40	16
BACKUP	SP-SUC-VENT	400	10	4x2,5+TTx2,5	Cu	1	300 AC	40	16
	SP-SUC-VENT	400							100
LT01	SP-TOILETS	230	30	2x1,5+TTx1,5	Cu	300	30 AC	40	10
LT02	SP-TOILETS	230	60	2x1,5+TTx1,5	Cu	340			10
EMERGENCY	SP-TOILETS	230	20	2x1,5+TTx1,5	Cu	50			10
HDRY01	SP-TOILETS	230	15	2x2,5+TTx2,5	Cu	2.100	30 AC	40	16
HDRY02	SP-TOILETS	230	20	2x2,5+TTx2,5	Cu	2.100			16
HDRY03	SP-TOILETS	230	15	2x2,5+TTx2,5	Cu	2.100	30 AC	40	16
HDRY04	SP-TOILETS	230	20	2x2,5+TTx2,5	Cu	2.100			16
AIR01	SP-TOILETS	230	20	2x2,5+TTx2,5	Cu	690	30 AC	25	16
BACKUP1	SP-TOILETS	230	20	2x2,5+TTx2,5	Cu	1	30 AC	40	16
BACKUP2	SP-TOILETS	230	15	2x2,5+TTx2,5	Cu	1			16
AUTDOOR	SP-TOILETS	230	20	2x2,5+TTx2,5	Cu	1.000	30 AC	25	16
	SP-TOILETS	400							63
LT01	SP-OFFICES	230	25	2x1,5+TTx1,5	Cu	1.205 W	30 AC	40	10
lt02	SP-OFFICES	230	30	2x1,5+TTx1,5	Cu	1.187 W			10
EMERGENCY	SP-OFFICES	230	35	2x1,5+TTx1,5	Cu	50 W			10

LT03	SP-OFFICES	230	25	2x1,5+TTx1,5	Cu	1.505 W	30 AC	40	10
LT04	SP-OFFICES	230	30	2x1,5+TTx1,5	Cu	992 W			10
LT05	SP-OFFICES	230	30	2x1,5+TTx1,5	Cu	524 W			10
EMERGENCY	SP-OFFICES	230	35	2x1,5+TTx1,5	Cu	50 W			10
PLUG01	SP-OFFICES	230	45	2x1,5+TTx1,5	Cu	1.500 W	30 AC	63	16
PLUG02	SP-OFFICES	230	40	2x2,5+TTx2,5	Cu	1.500 W			16
PLUG03	SP-OFFICES	230	40	2x2,5+TTx2,5	Cu	1.500 W			16
CLI05	SP-OFFICES	230	40	2x2,5+TTx2,5	Cu	2.500 W	300 AC	40	16
PLUG04	SP-OFFICES	230	45	2x2,5+TTx2,5	Cu	1.500 W	30 AC	63	16
PLUG05	SP-OFFICES	230	25	2x2,5+TTx2,5	Cu	1.500 W			16
PLUG06	SP-OFFICES	230	44	2x2,5+TTx2,5	Cu	1.500 W			16
CLI01	SP-OFFICES	230	25	2x2,5+TTx2,5	Cu	2.497 W	30 AC	63	16
CLI02	SP-OFFICES	230	30	2x2,5+TTx2,5	Cu	1.705 W			16
CLI03	SP-OFFICES	230	35	2x2,5+TTx2,5	Cu	2.205 W			16
CLI04	SP-OFFICES	230	40	2x2,5+TTx2,5	Cu	2.500 W	300 AC	40	16
DOOR	SP-OFFICES	230	35	2x2,5+TTx2,5	Cu	1.000 W	300 AC	40	16
	SP-OFFICES	400							63
PSAI11	SP-INFORMATICS	230	50	2x2,5+TTx2,5	Cu	1.000	30 AC	40	16
PSAI12	SP-INFORMATICS	230	40	2x2,5+TTx2,5	Cu	1.000			16
PSAI01	SP-INFORMATICS	230	50	2x2,5+TTx2,5	Cu	1.000	30 AC	40	16
PSAI02	SP-INFORMATICS	230	15	2x2,5+TTx2,5	Cu	1.000			16
PSAI03	SP-INFORMATICS	230	20	2x2,5+TTx2,5	Cu	1.000	30 AC	40	16
PSAI04	SP-INFORMATICS	230	20	2x2,5+TTx2,5	Cu	1.000			16

PSAI05	SP-INFORMATICS	230	20	2x2,5+TTx2,5	Cu	1.000	30 AC	40	16
PSAI06	SP-INFORMATICS	230	15	2x2,5+TTx2,5	Cu	1.000			16
PSAI07	SP-INFORMATICS	230	20	2x2,5+TTx2,5	Cu	1.000	30 AC	40	16
PSAI08	SP-INFORMATICS	230	20	2x2,5+TTx2,5	Cu	1.000			16
PSAI09	SP-INFORMATICS	230	20	2x2,5+TTx2,5	Cu	1.000	30 AC	40	16
PSAI10	SP-INFORMATICS	230	20	2x2,5+TTx2,5	Cu	1.000			16
AIRCON01	SP-INFORMATICS	230	15	2x2,5+TTx2,5	Cu	690	300 AC	25	16
RACK COM1	SP-INFORMATICS	230	15	2x2,5+TTx2,5	Cu	500	30 AC	40	16
RACK SER1	SP-INFORMATICS	230	15	2x2,5+TTx2,5	Cu	500			16
RACK COM2	SP-INFORMATICS	230	20	2x2,5+TTx2,5	Cu	500	30 AC	40	16
RACK SER2	SP-INFORMATICS	230	20	2x2,5+TTx2,5	Cu	500			16
CCTV	SP-INFORMATICS	230	20	2x2,5+TTx2,5	Cu	1.500	300 AC	40	16
SP-SAILOG	SP-INFORMATICS	230	150	2x10+TTx10	Cu	3.000			32
SP-RACK B	SP-INFORMATICS	230	140	2x10+TTx10	Cu	2.400			32
	SP-INFORMATICS	400							63

	SP-INFORMATICS	400							63
	SP-INFORMATICS	400							63
	SP-INFORMATICS	400							63
PSAI01	SP-SAILOG	230	10	2x2,5+TTx2,5	Cu	1.000	30 AC "si"	40	16
PSAI02	SP-SAILOG	230	10	2x2,5+TTx2,5	Cu	1.000			16
PSAI03	SP-SAILOG	230	15	2x2,5+TTx2,5	Cu	1.000	30 AC "si"	40	16
	SP-SAILOG	230							63
PRACKB01	SP-RACKB	230	15	2x2,5+TTx2,5	Cu	600	30 AC "si"	40	16
PRACKB02	SP-RACKB	230	15	2x2,5+TTx2,5	Cu	600			16
PRACKB03	SP-RACKB	230	15	2x2,5+TTx2,5	Cu	600	30 AC "si"	40	16
PRACKB04	SP-RACKB	230	20	2x2,5+TTx2,5	Cu	600			16
	SP-RACKB	230							63
LT01	SP-FIREPROT	230	35	2x1,5+TTx1,5	Cu	288	30 AC	25	10
EMERGENCY	SP-FIREPROT	230	30	2x1,5+TTx1,5	Cu	50			10
PLUG	SP-FIREPROT	230	25	2x2,5+TTx2,5	Cu	2.000	30 AC	25	16
Power (W) GRILL	SP-FIREPROT	230	25	2x2,5+TTx2,5	Cu	1.250	30 AC	25	16
CHLORINATION	SP-FIREPROT	230	20	2x2,5+TTx2,5	Cu	250	30 AC	25	16
AEROTHERM	SP-FIREPROT	400	25	4x6+TTx6	Cu	5.000	300 AC	25	25
RESISTANCE TANK	SP-FIREPROT	400	20	4x2,5+TTx2,5	Cu	3.000	30 AC	25	16
	SP-FIREPROT	400							63
CONTROL VENTILATION	SP-VENTILATION	230	10	2x2,5+TTx2,5	Cu	200	30 AC	25	16
EXTRACT01	SP-VENTILATION	400	95	4x2,5+TTx2,5	Cu	2.400	300 AC	25	16
EXTRACT02	SP-VENTILATION	400	95	4x2,5+TTx2,5	Cu	2.400	300 AC	25	16

EXTRACT03	SP-VENTILATION	400	95	4x2,5+TTx2,5	Cu	2.400	300 AC	25	16
EXTRACT04	SP-VENTILATION	400	95	4x2,5+TTx2,5	Cu	2.400	300 AC	25	16
EXTRACT05	SP-VENTILATION	400	95	4x2,5+TTx2,5	Cu	2.400	300 AC	25	16
EXTRACT06	SP-VENTILATION	400	95	4x2,5+TTx2,5	Cu	2.400	300 AC	25	16
BACKUP	SP-VENTILATION	400	45	4x2,5+TTx2,5	Cu	1	300 AC	25	16
BACKUP	SP-VENTILATION	400	45	4x2,5+TTx2,5	Cu	1	300 AC	25	16
BACKUP	SP-VENTILATION	400	45	4x2,5+TTx2,5	Cu	1	300 AC	25	16
	SP-VENTILATION	400							100
LT01	SP-LIGHTING	230	50	2x2,5+TTx2,5	Cu	1.880	30 AC	63	16
LT03	SP-LIGHTING	230	40	2x2,5+TTx2,5	Cu	1.880			16
EMERGENCY01	SP-LIGHTING	230	40	2x1,5+TTx1,5	Cu	150			10
LT02	SP-LIGHTING	230	40	2x2,5+TTx2,5	Cu	1.880	30 AC	63	16
LT04	SP-LIGHTING	230	40	2x2,5+TTx2,5	Cu	940			16
LT06	SP-LIGHTING	230	40	2x2,5+TTx2,5	Cu	222			16
LT05	SP-LIGHTING	230	50	2x2,5+TTx2,5	Cu	1.385	30 AC	40	16
LT11	SP-LIGHTING	230	60	2x2,5+TTx2,5	Cu	762			16
LT07	SP-LIGHTING	230	50	2x2,5+TTx2,5	Cu	1.504	30 AC	63	16
LT09	SP-LIGHTING	230	50	2x2,5+TTx2,5	Cu	1.504			16
EMERGENCY02	SP-LIGHTING	230	60	2x1,5+TTx1,5	Cu	150			10
LT12	SP-LIGHTING	230	50	2x2,5+TTx2,5	Cu	1.397	30 AC	63	16
LT13	SP-LIGHTING	230	50	2x2,5+TTx2,5	Cu	1.397			16

LT14	SP-LIGHTING	230	80	2x2,5+TTx2,5	Cu	376			16
LT08	SP-LIGHTING	230	50	2x2,5+TTx2,5	Cu	1.504	30 AC	63	16
LT10	SP-LIGHTING	230	40	2x2,5+TTx2,5	Cu	752			16
DALI	SP-LIGHTING	230	10	2x2,5+TTx2,5	Cu	2.000	30 AC	25	16
	SP-LIGHTING	400							63
LT01	SP-DINING	230	15	2x1,5+TTx1,5	Cu	279 W	30 AC	25	10
EMERGENCY	SP-DINING	230	15	2x1,5+TTx1,5	Cu	50 W			10
SEM01	SP-DINING	230	15	2x2,5+TTx2,5	Cu	1.500 W	30 AC	63	16
SEM02	SP-DINING	230	15	2x2,5+TTx2,5	Cu	1.500 W			16
CPLUGS	SP-DINING	230	25	2x2,5+TTx2,5	Cu	600 W	30 AC	25	16
DOOR	SP-DINING	230	15	2x2,5+TTx2,5	Cu	600 W	30 AC	25	16
	SP-DINING	400							63
DISP01	SP-DYE	400	15	4x2,5+TTx2,5	Cu	300 W	30 AC	40	16
AGI01	SP-DYE	400	15	4x2,5+TTx2,5	Cu	750 W			16
COM01	SP-DYE	400	15	4x2,5+TTx2,5	Cu	2.400 W	30 AC	25	16
AIR01	SP-DYE	400	15	4x2,5+TTx2,5	Cu	1.500 W	30 AC	40	16
LIFT01	SP-DYE	400	20	4x2,5+TTx2,5	Cu	367 W			16
AGI02	SP-DYE	400	15	4x2,5+TTx2,5	Cu	367 W			16
SERBOX	SP-DYE	400	20	4x10+TTx10	Cu	2.000 W	30 AC	40	40
LT01	SP-DYE	230	15	2x1,5+TTx1,5	Cu	863 W	30 AC	40	10
LT02	SP-DYE	230	20	2x1,5+TTx1,5	Cu	863 W			10
LT03	SP-DYE	230	20	2x1,5+TTx1,5	Cu	863 W			10
EMERGENCY	SP-DYE	230	20	2x1,5+TTx1,5	Cu	50 W			10
	SP-DYE	400							63

Table 1.13.1. Resume of lines (Source: Nil Domenech)

1.14. RESUME OF SHORT CIRCUIT CURRENTS

Panel	Plate sec. (mm^2)	Max. Curr. (A)	Calc. Curr. (A)	Short Circ. Curr. (kA)
EPBT	500	1200	909.35	21.83
GPCP	500	1200	879,66	20,96
SP-WEATHER	100	290	61,73	9,25
SP-COMP	100	290	124,32	9,25
SP-WAREHOUSE	45	170	93,64	4,48
SP-OFILOG	24	110	17,5	1,56
SP-EMBA244	100	290	147,06	9,75
SP-EMBA170	100	290	180,61	9,52
SP-PROD1	45	170	55,79	4,17
SP-WORKSHOP	24	110	9,87	1,73
SP-PROD2	75	270	92,8	5,9
SP-BOBST	45	170	77,42	4,89
SP-TRANSFER	30	140	20,56	3,07
SP-EXT	24	110	5,02	0,52
SP-SUCTION	40	185	111,4	3,41
SP-SUC-VENT	24	110	83,49	1,53
SP-TOILETS	24	110	6,59	0,78
SP-OFFICES	24	110	30,14	2,96
SP-INFORMATICS	24	110	19,79	2,49
SP-SAILOG	24	110	13,04	0,44
SP-RACKB	24	110	13,04	0,46
SP-FIREPROT	24	110	21,99	2,1
SP-VENTILATION	45	170	16,89	4,43
SP-LIGHTING	24	110	14,21	2,1

SP-DINING	24	110	4,59	0,62
SP-DYE	24	110	10,43	0,62

Table 1.13.1. Resume of short circuit (Source: Nil Domenech)

BIBLIOGRAPHY

This document has been made according to the electrotechnical regulations of low tension (REBT) and the complementary technical instructions (ITC-BT). In addition has been used the Vademecum of Endesa.

To make the Budget, we have used the prices of Ediciones Tarifec, S.A.

No more documents has been used to made this project.